

PRESSURE DISTRIBUTION SYSTEM

Description. A low pressure system of small diameter perforated plastic pipe laterals, manifold, pressure transport line, dosing chamber and a pump or siphon.

Conditions for Approval.

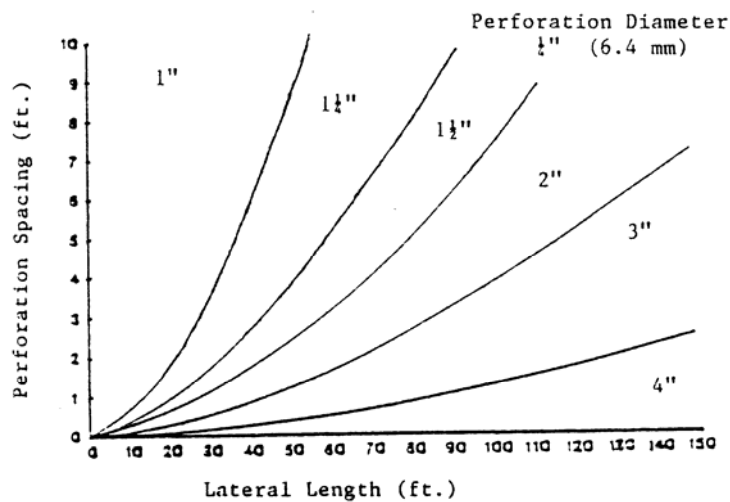
1. The pressure distribution system is to be used whenever it is desirable to:
 - a. Maintain a uniform application rate throughout the drainfield.
 - b. Treat and dispose of effluent in the uppermost levels of the soil profile.
 - c. Aid in mitigating the potential contamination of groundwater in areas of excessive permeability.
 - d. Improve the performance and increase the life span of a drainfield.
2. Pressure distribution may be used in sand mounds, sand filters, sand-filled trenches and standard trenches in aquifer-sensitive areas or in large drainfields. Geotextile filter fabrics are required to be used for cover over pressure distribution systems.
3. These guidelines provide for a simple strategy of design to assist the non-engineer. They are not intended to supplant or limit engineering design or other low pressure systems. The guidance should not be used where laterals are at different elevations (elevation differences greater than 6") or for systems with daily flows over 2,500 gallons. Plans for systems with designs different than those provided herein shall be reviewed by the Department of Environmental Quality. The following guide is recommended for pressure system design outside of these guidelines:

Otis, R.J. 1981. Design of Pressure Distribution Networks for Septic-Tank Absorption Systems. Small Scale Waste Management Project Publication #9.6. University of Wisconsin, Madison, WI.

Design.

1. Laterals
 - a. The lateral length should be shorter than the trench length by at least 6" but not more than one-half the orifice spacing.
 - b. Laterals in trenches should be placed equidistant from each side.
 - c. The lateral spacing in beds is typically 3 to 6 feet. The outside laterals should be placed at one-half the selected lateral spacing from the bed's edge.
 - d. A preliminary estimate of orifice spacing should be made. Normally, the first estimate will be one-half the lateral spacing. For most installations the spacing will be between 18" and 36".
 - e. The orifice diameter should be ¼" (0.25"). A residual head of 2.5 feet is used for calculating flows and pump size. The flow through each orifice at that head will be 1.17 gallons per minute. Testing of the residual head shall be made on each lateral for terraced systems. Testing may be accomplished by placing the last orifice on a lateral in the up position and plugging the orifice with the lateral end cap or placing a screw in the orifice.

- f. Determine the lateral diameter from the following figure: (if a smaller diameter orifice is used, flow will change and the following table cannot be used).



- g. The laterals should not exceed the lengths below for the pipe anticipated to be used.

Lateral Diameter, Inches	Orifice Spacing, Feet	Schedule 40	Class 200	Class 160	Class 125
1.0	1.5	16.5	21	21	-
1.0	2.0	20	24	24	-
1.0	2.5	22.5	27.5	27.5	-
1.0	3.0	27	33	33	-
1.25	1.5	27	30	31.5	31.5
1.25	2.0	32	36	38	38
1.25	2.5	37.5	42.5	45	45
1.25	3.0	42	48	48	51
1.5	1.5	34.5	39	39	40.5
1.5	2.0	42	46	48	50
1.5	2.5	47.5	52.5	55	57.5
1.5	3.0	54	60	63	63
2.0	1.5	52.5	55.5	58.5	60
2.0	2.0	64	68	70	72
2.0	2.5	72.5	77.5	80	82.5
2.0	3.0	81	87	90	93

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- h. Calculate the lateral and total discharge rates:

Lateral Discharge Rate, gpm = 1.17 x number of orifices

Total Discharge Rate, gpm = Lateral Rate x number of laterals

- i. Individual ball valves shall be installed on each lateral to balance residual head on terraced systems.

2. Manifold: Determine the manifold size from the following Table:

Lateral Discharge Rate (g.p.m.)		Manifold Diameter = 13"	Manifold Diameter = 12"	Manifold Diameter = 2"	Manifold Diameter = 3"	Manifold Diameter = 4"
			Lateral Spacing	Lateral Spacing	Lateral Spacing	Lateral Spacing
End	Central	2 4 6 8 10	2 4 6 8 10	2 4 6 8 10	2 4 6 8 10	2 4 6 8 10
10	/ 5	4 8 6 8 10	10 8 12 16 20	12 16 24 24 30	26 40 48 56 70	42 64 84 96 110
20	/ 10	4 4 6	4 4 6 8 10	6 8 12 16 20	16 24 30 32 40	26 40 54 64 70
30	/ 15	2	2 4 6	4 8 6 8 10	12 16 24 24 30	20 28 36 48 50
40	/ 20			4 4 6 8 10	10 12 18 16 20	16 24 30 32 40
50	/ 25			2 4 6 8	8 12 12 16 20	14 20 24 32 40
60	/ 30			2 4	6 8 12 16 20	12 16 24 24 30
70	/ 35			2 4	6 8 12 8 10	10 16 18 24 30
80	/ 40			2	6 8 6 8 10	10 12 18 16 20
90	/ 45			2	4 8 6 8 10	8 12 18 16 20
100	/ 50			2	4 4 6 8 10	8 12 12 16 20
110	/ 55				4 4 6 8 10	8 12 12 16 20
120	/ 60				4 4 6 8 10	6 8 12 16 10
130	/ 65				4 4 6 8 10	6 8 12 16 10
140	/ 70				2 4 6 8	6 8 12 8 10
150	/ 75				2 4 6	6 8 12 8 10
160	/ 80				2 4 6	6 8 6 8 10
170	/ 85				2 4 6	4 8 6 8 10
180	/ 90				2 4	4 8 6 8 10
190	/ 95				2 4	4 8 6 8 10
200	/ 100				2 4	4 4 6 8 10

Example A: Central Manifold

Lateral Q = 40 gpm

Lateral Spacing = 6'

Manifold Length = 18'

Manifold Diameter = 4"

Example B: Terminal Manifold

Lateral Q = 30 gpm

Lateral Spacing = 6'

Manifold Length = 24'

Manifold Diameter = 3"

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3. Transport (Pressure) Line: Determine the diameter of the transport line from the following table. (The table is specifically for ABS schedule 40 pipe with a Hazen-Williams Coefficient of 150).

Friction Loss in feet per one hundred feet
Pipe Diameter, in inches

Flow, GPM	1"	1 1/2"	2"	2 1/2"	3"	4"
5	1.52	0.39	0.18			
6	2.14	0.55	0.25	0.07		
7	2.89	0.76	0.36	0.10		
8	3.63	0.97	0.46	0.14		
9	4.57	1.21	0.58	0.17		
10	5.50	1.46	0.70	0.21		
11		1.77	0.84	0.25		
12		2.09	1.01	0.30		
13		2.42	1.17	0.35		
14		2.74	1.33	0.39		
15		3.06	1.45	0.44	0.07	
16		3.49	1.65	0.50	0.08	
17		3.93	1.86	0.56	0.09	
18		4.37	2.07	0.62	0.10	
19		4.81	2.28	0.68	0.11	
20		5.23	2.46	0.74	0.12	
25			3.75	1.10	0.16	
30			5.22	1.54	0.23	
35				2.05	0.30	0.07
40				2.62	0.39	0.09
45				3.27	0.48	0.12
50				3.98	0.58	0.16
60					0.81	0.21
70					1.08	0.28
80					1.38	0.37
90					1.73	0.46
100					2.09	0.55
150						1.17

Example: The transport line will be 50' long and flow is calculated at 20 gpm. The headloss for 100' of 1 1/2" diameter pipe is 2.46'. For 50' it would be 1.23'.

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4. Calculate the total head:

$$\text{Total Head} = E + T + R$$

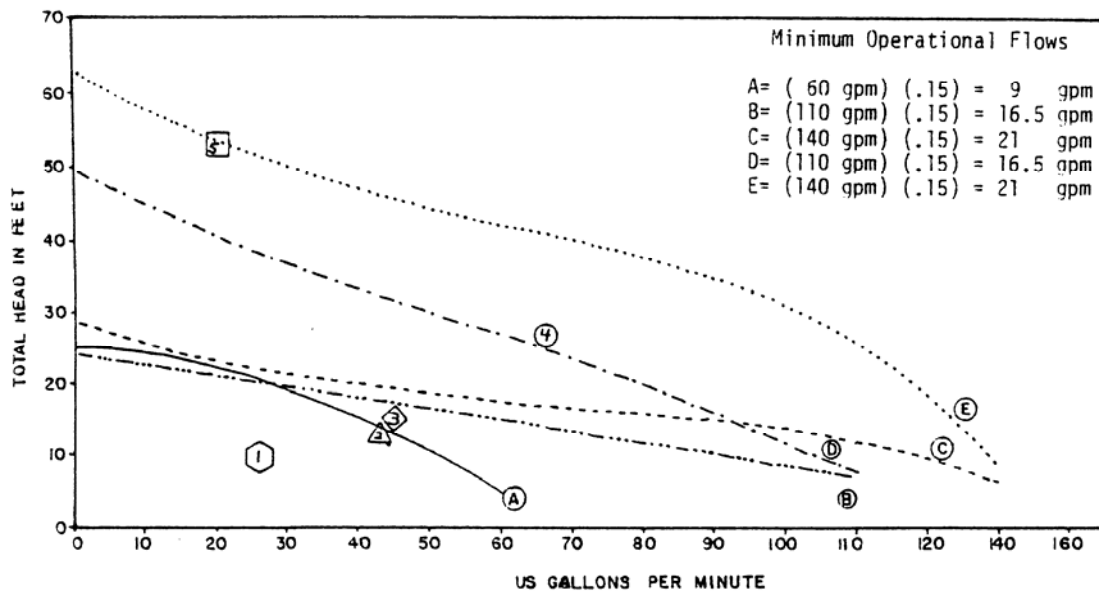
Where: E = elevation difference between the pump and the manifold.

T = transport pressure line head.

R = residual head (2.5 feet).

5. Pump:

- a. Pump selection is a critical part of the system design package. It is based on the discharge rate and pumping head required for the system. Using the pump head-discharge rate curves supplied by the manufacturer, select a pump at the required head.
- b. To help maximize pump efficiency, pump selection should also address maximum usable head. Select pumps where the operating point will be greater than 15 percent of the maximum pump rate (maximum gpm rating). For example, a pump with a maximum capacity of 80 gpm should only be used if the operational requirement is greater than $80 \text{ gpm} \times 0.15$ or 12 gpm.
- c. The preceding will help illustrate proper pump selection. Five pump curves are shown in the following example. In the upper right corner of the graph are the calculations showing the minimum operational flows based on the 15% pump curve efficiency requirement. In the table several system requirements are shown with the pumps ultimately selected.



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System	GPM	TDH	Pump Selected	Comments
1	26	9'	A, B, or C	All pumps will work, but because of price and serviceability pump A, B or C were Selected.
2	43	13'	A, B, or C	Price and Serviceability
3	45	15'	B, or C	Pump A not adequate
4	67	26'	E	Pump D might be adequate. Check the operation point.
5	20	53'	N/A	20 GPM is less than 15 % of the maximum flow for pump E.

d. Other pump considerations:

- Pump should be specified for effluent.
- Pump should transfer solids as large as orifice diameter.
- Pump should be serviceable from ground level without the need to enter the pump chamber. PVC unions are available which assist in the easy removal of pumps.
- Pumps and electrical connections shall conform to the requirements of the Division of Building Safety, Electrical Bureau. Pumps must be kept submerged and all connections made outside the chamber in an explosion proof box for multiple residential and commercial installations. For individual residential systems the electrical connections may be made in a weatherproof box. Both systems require the use of a seal off. See figures and page 58-59 for details.
- Impellers shall be cast iron, bronze, or other corrosion-resistant material. Regardless of the material, the impeller may freeze if the pump remains inactive for several months.
- If for any reason a check valve is used, a bleeder hole should be installed so the volute is kept filled with effluent. Some pumps may run backwards if the impeller is in air.

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6. Dosage.

a. Determine the dose volume by the following sets of design criteria:

1) Soil Type:

Determine the dose volume by dividing the average daily flow, in gpm, by the following recommended dosing frequency:

<u>Soil Texture at Drainrock Interface</u>	<u>Doses per Day</u>
Medium and fine sand	4
Loamy sand, sandy loam	1-2
Loam and finer soils	1

2) Dose/Volume Ratio:

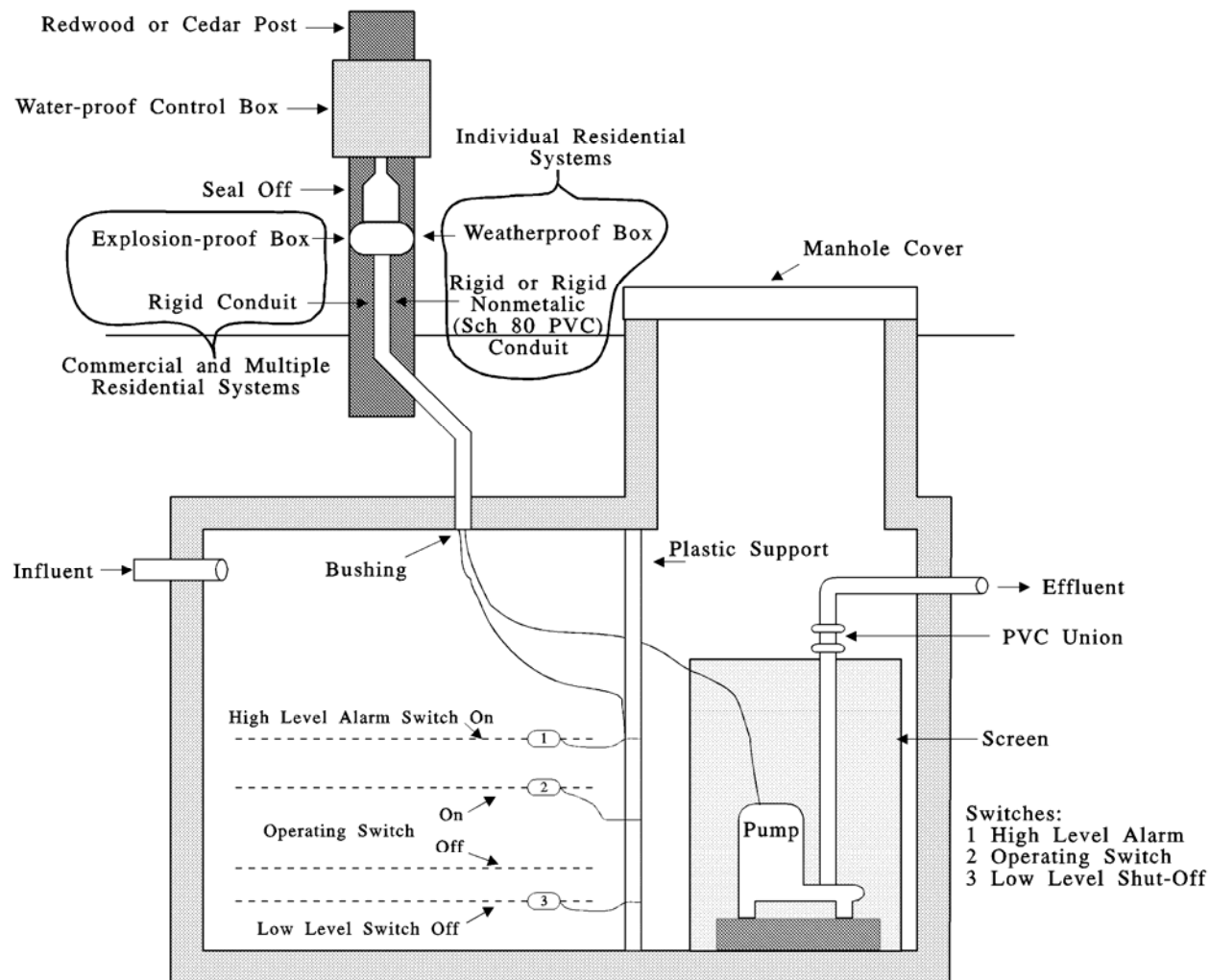
- a) The daily dose volume ratio should be at least 7 times the volume of the manifold and lateral piping which drains between doses plus one time the interior volume of the transport line. If the dose is too small, then the pipe network will not become fully pressurized or may not be pressurized for a significant portion of the total dosing cycle.
- b) It may be necessary to modify the piping network configuration to reduce the pipe volume or space which drains between doses.
- c) Use the following table to calculate distribution line, manifold, and transport line volumes. Calculate only pipe volumes that drain between doses.

Volume (Gal/ft of Length)

Diameter (Inches)	Schedule 40	Class 200	Class 160	Class 125
1	0.045	0.058	0.058	----
13	0.078	0.092	0.096	0.098
12	0.105	0.120	0.125	0.130
2	0.175	0.189	0.196	0.204
3	0.385	0.417	0.417	0.435
4	0.667	0.667	0.714	0.714
6	1.429	1.429	1.429	1.667

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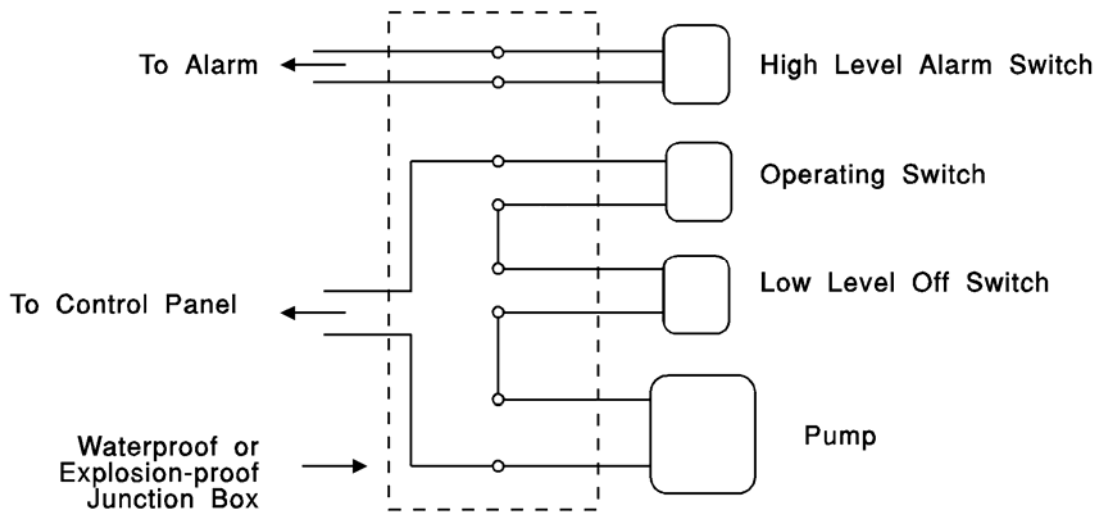
7. Dosing Chamber:



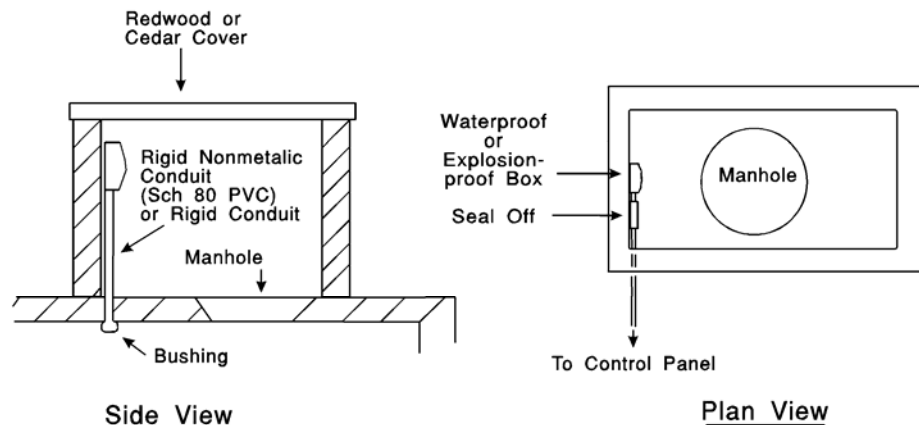
- a. The dosing chamber must be watertight, with all joints sealed. Precautions must be made in high-groundwater areas to prevent the tank from floating.
- b. A screen must be placed around the pump with 1/8" holes or slits of non-corrosive material and have a minimum of 12 square feet of area. Its placement must not interfere with the floats and it should be easily removable for cleaning. Effluent filter designs fitted with a closing mechanism are a suitable alternative to screens around pumps.
- c. Electrical Requirements (Contact the Division of Building Safety, Electrical Bureau):
 - 1) Visual or audio alarms on a separate circuit from the pump must be provided to indicate when the level of effluent in the pump or siphon chamber is higher than the height of the volume of one dose.
 - 2) All electrical connections must be made outside of the chamber in either an approved weatherproof box or an explosion-proof junction box (Crouse-Hind Type EAB or equivalent). The lines from the junction box to the control box must pass through a sealing fitting (seal-off) to prevent corrosive gases from entering the control panel. All wires must be contained in solid conduit from the dosing chamber to the control box.

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- 3) The minimum effluent level must be above the pump. This is the level that the low level off switch is set and should be 2" to 3" above the pump.
- 4) An acceptable circuit is shown in the following diagram:



- 5) Plans and schematics for the electrical installation should be approved by the Division of Building Safety, Electrical Bureau prior to installation and at the same time the permit is issued.
- 6) An alternative to placing the electrical connections on a pole is to place them in a dry well over the dosing chamber. The following diagram shows an arrangement acceptable to the Electrical Bureau:



- d. The volume of the dosing chamber should be equal to at least two day's flow. A 750-gallon tank will provide sufficient volume to keep the pump covered with effluent, provide an 80-gallon to 120-gallon dose and store one day's flow for most single dwelling installations.

8. In-Tank Pumps. Placement of sewage effluent pumps in a septic tank is an acceptable practice under the following conditions:
- a. Sewage effluent pumps must be placed in an approved pump vault.
 - b. The drawdown of effluent from the septic tank is limited to a maximum 120 gallons per dose with a maximum pump rate of 30 GPM.
 - c. Septic tanks must be sized to allow for one days flow above the high water alarm, unless a duplex pump is used.
 - d. The pump vault inlets must be set at fifty (50%) percent of the liquid volume.
 - e. Placement of the pump vault inside the septic tank shall be in accordance with the manufacturer' recommendations.
 - f. Pump vault screens shall be one-eighth inch (1/8") holes, or slits (or smaller); be constructed of non-corrosive material; and have a minimum of 12 square feet of area.
 - g. Placement of the pump vault and pump must not interfere with the floats or alarm and pump vault should be easily removable for cleaning.

